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Appendix H

Alternative Measures of Change in Wage Earners per Unit of Product



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THE declines in workers per unit turned out to be so large that we thought it well to make sure they were not the result of some quirk in our methods of computation. It must be remembered that the changes we find in wage earners per unit of product are conditioned by the technical characteristics of the particular methods we employ in passing from the available samples of industries for which output data are obtainable to the group totals or the total of all industries combined. We should therefore compare our indexes of wage earners per unit with measures restricted to the samples or estimated for the entire group or grand total by alternative methods.

A group index is based, to begin with, on a sample of industries in that group for which the Census has collected adequate data on quantity of physical output. The index covering the sample is identified in the accompanying table by the term "unadjusted." This sample index we adjusted for changes in the sample's relative importance (this involved adjusting the index of output, as described in *The Output of Manufacturing Industries, 1899-1937*, Chapter 2 and Appendix A, and using an index of employment in the entire group rather than in the sample industries alone). The resulting adjusted index is identified in Table H-1 by the word "adjusted."¹ In the case of the index for total manufacturing, two methods of passing from the sample index of output to the adjusted index of output (identified by "A" and "B") were used; these methods are described in detail in the source cited.

¹ No similar comparison could be made of the adjusted indexes for individual industries with indexes restricted to the samples of products for which quantity data are available, because employment data are given by the Census

The indexes of output (and, therefore, of workers per unit) for the years 1899–1904 were computed on the 1909 base; those for 1909–14, on the 1919 base; those for 1919–37, on the 1929 base; and those for 1939, on the 1937 base. Comparisons between 1899 and 1937, for example, we then made *via* 1929, 1919 and 1909, by chaining the various indexes. Indexes obtained by chaining are called here “chain comparisons.” To check the chain comparison between 1899 and 1937 we computed a special set of indexes for 1937 on the 1899 base. These are called “direct comparisons” in the table below.

It is clear from the table that alternative methods yield changes in wage earners per unit for all manufacturing combined that differ only fractionally from one another. As for the groups, only for forest products are the several measures of net change over the 38 years from 1899 to 1937 considerably different from one another. Yet even in this case the signs of all the changes indicated are uniform. For decade periods, also, the alternative measures differ in only a few cases, and in no case is the difference greater than 10 percent.²

²Not only are there various ways of deriving measures of percentage changes in workers per unit of product; there are also different methods of measuring change in this ratio. Arithmetic changes, for example, are as reasonable measures as percentage changes. If 5 men were employed in turning out a unit of a certain product in 1899 and 4 men in 1937, the decline can be measured either by 1 man or by 20 percent. (Since units vary between industries, there is a problem of setting up a homogeneous unit of product so that arithmetic changes in number of workers per unit in various industries can be compared with one another; for such a unit see the last section of Chapter 2, above.) As a matter of fact, arithmetic and percentage changes in workers per unit are highly correlated: industries with relatively large declines according to one measure usually show large declines also according to the other measure.

TABLE H-1
MAJOR GROUPS AND TOTAL MANUFACTURING
Comparison of Alternative Measures of Wage Earners per Unit of Product: Percentage Changes
over Specified Periods

Group	Net Percentage Change between 1899 and 1937				Net Percentage Change between 1899 and 1909				Net Percentage Change between 1909 and 1919				Net Percentage Change between 1919 and 1929				Net Percentage Change between 1929 and 1937			
	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed
	Chain				Direct				Comparison				Comparison				Comparison			
Foods	-26	-22	-28	-22	-7	-11	+13	+15	+35	-30	+8	+8	+35	-30	+8	+8	+35	-30	+8	+8
Beverages	-30	-31	-33	-35	-4	-3	+94	+87	..	..	..	..	..	..	..	..	..	..	..	..
Tobacco products	-82	-82	-81	-81	-14	-13	-41	-41	-48	-48	-32	-32	-48	-48	-32	-32	-48	-48	-32	-32
Textile products	-37	-35	-36	-36	-12	-10	0	-3	-29	-25	0	0	-29	-25	0	0	-29	-25	0	0
Leather products	-21	-24	-22	-24	-4	-4	+3	-1	-18	-15	-4	-4	-18	-15	-4	-4	-18	-15	-4	-4
Rubber products	..	..	..	..	..	..	..	..	-50	-50	-4	-4	-50	-50	-4	-4	-50	-50	-4	-4
Paper products	-59	-55	-51	-55	-23	-18	+1	+4	-41	-41	-11	-11	-41	-41	-11	-11	-41	-41	-11	-11
Printing and publishing ^a	-70	-70	-70	-70	-36	-36	-27	-27	-34	-34	-2	-2	-34	-34	-2	-2	-34	-34	-2	-2
Chemical products	-57	-58	-56	-56	-16	-18	+12	+5	-50	-44	-9	-9	-50	-44	-9	-9	-50	-44	-9	-9
Petroleum and coal products	-73	-76	-70	-74	-21	-25	-14	-20	-56	-57	-9	-9	-56	-57	-9	-9	-56	-57	-9	-9
Stone, clay and glass products	..	..	..	..	..	..	..	..	..	..	-6	-7	..	..	-6	-7	..	..	-6	-7
Forest products	+10	+21	+8	+19	+32	+33	-4	-6	-20	-11	+8	+8	-20	-11	+8	+8	-20	-11	+8	+8
Iron and steel products	-46	-45	-45	-42	-32	-32	+7	+6	-39	-36	+22	+19	-39	-36	+22	+19	-39	-36	+22	+19
Nonferrous-metal products	..	..	..	..	..	..	..	..	..	..	+18	+14	..	..	+18	+14	..	..	+18	+14
Transportation equipment	-74	-74	-63	-63	-12	-12	-41	-41	-58	-59	+19	+20	-58	-59	+19	+20	-58	-59	+19	+20
TOTAL MANUFACTURING	-52	-52	-54	-55	-13	-14	-10	-10	-40	-39	-2	+1	-40	-39	-2	+1	-40	-39	-2	+1
Adjusted by method A	-54	-54	-54	-54	-13	-13	-10	-10	-40	-39	-2	-1	-40	-39	-2	-1	-40	-39	-2	-1
Adjusted by method B	-49	-49	-47	-47	-12	-12	-4	-4	-39	-39	-1	-1	-39	-39	-1	-1	-39	-39	-1	-1

^a For printing and publishing there is only one series, covering the entire group.

